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Research Article

The Relationship between Unemployment Rates and Renewable Energy Consumption: Evidence from Fourier ADL Cointegration Test

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ABSTRACT

Unemployment remains an unsolved problem for both developing and developed countries. Solving this problem is one of the important aims for policymakers. In this study, we try to answer the question that whether new energy technologies create new employment areas or not and help to solve unemployment problem. To this end, we use a recently introduced cointegration test that allows structural breaks whose number, location, and form do not affect the accuracy of the test, to examine the long - term relationship between unemployment rates and renewable energy consumption for selected countries of the Organisation for Economic Co-operation and Development (OECD). The results show that there is a cointegration relationship between the variables for Australia, Austria, Chile, France, Germany, Japan, Mexico, Portugal, Spain and United States. The results show that renewable energy consumption positively affects the unemployment rates for Austria, Portugal, and Spain, while it negatively affects the unemployment rates for Australia, Chile, France, Germany, and Japan.

Keywords: Fourier ADL Cointegration Test, Unemployment, Renewable Energy Consumption

1. Introduction

The current development of renewable energy technologies causes various changes in the energy sector. The increasing share of renewable energy consumption in total energy consumption has indisputably positive mitigating effects on global warming, as well as decreasing our energy dependency and CO2 emissions (Moreno and Lopez, 2008). At the same time, because one of the major global problems is high unemployment, the effects of renewable energy development on new employment creation are of great importance. In the literature, many studies examine the relationship between renewable energy consumption and economic growth (see Apergis and Payne, 2010; Apergis and Payne, 2011; Menyah and Wolde Rufael, 2010; Sadorsky, 2009; Fang, 2011; Bakırtaş and Çetin, 2016, among others).

Few studies, however, directly examine the relationship between energy consumption and unemployment. Based on the empirical results of research investigating the relationship between energy consumption and economic growth and considering Okun's law, energy consumption in the economy, especially the consumption of renewable energy, affects the unemployment rate. This is an important indicator of economic growth (Apergis and Salim, 2015). According to the Green Economy Report, transition to renewable energy sources creates many new employment opportunities. Compared with traditional energy production, increasing investment in the various renewable energy technologies will contribute to the short-term employment rate due to the high labor intensity, and the unemployment rate will decrease. The impact of renewable energy investment on employment will vary in the national context depending on supporting policies, available resources, and national energy systems (UNEP, 2011).

Economic activity in the renewable energy field appears to reflect employment and unemployment differently. Investments in the field of renewable energy and the increase of the positive externalities caused by these investments have created more employment and decreased import bills and energy dependency that have contributed to employment. New areas of employment created by renewable energy industries and their technologies increase welfare levels by decreasing unemployment rates (Zhao and Luo, 2017; Bayraktar and Kaya, 2016; Makower et al., 2009; Orucu and Alp, 2007; NREL, 1997).

This paper discusses positive and negative effects of renewable energy investments and the "green economy" on employment. The positive employment effects are categorized as direct effects, indirect effects, and stimulated effects. The direct employment effect means the first-round effects arising from the increasing demand, production, and employment induced by environment protection expenditures. Direct employment consists of the workers in the production of materials to be used in renewable energy investments and the workers employed in the project's planning, installation, maintenance, and plant repair. The indirect effect usually consists of secondary industries that provide input to the primary sector. The indirect employment effect is defined as the second- and third-round effects resulting from the inclusion of peripheral expenditures and other non-peripheral expenditures. The stimulated effect is employment induced by direct and indirect employment caused by renewable energy investments, including the gains of taxable

income-generating governments and other stakeholders who provide income from these investments to the economy. In other words, expenditures lead to an increase in additional income in the economy due to the multiplier effect of additional employment (Karaca, 2017; Özsoy, 2016; OECD, 2004: 9-10; Kammen et al., 2004). When negative effects are observed, every job loss caused by replacing a number of traditional jobs with fewer green jobs and fossil energy sources with renewable energy sources as well as green goods and services could affect employment negatively. For instance, an increase in the consumption of renewable energy reduces the demand for fossil fuels and thus affects the supply of the coal mining industry. In this way, the losses that can arise directly and indirectly are added to the gross loss in employment. Environmental programs can also cause negative employment effects as they may cause some manufacturing plants to shut down. Environmental programs can lead to price increases and thus may lead to a decrease in demand, production, and employment (Karaca, 2017; Özsoy, 2016; OECD, 2004: 9-10; Kammen et al., 2004).

The literature on energy economics show that; the great majority of the studies examine the relationship between renewable/non-renewable energy consumption and economic growth. (see Ozturk, 2010). There are not enough studies on the determination of the positive/negative effect of energy consumption on unemployment (see George and Oseni 2012, Bilgili et al. 2017, among others.). On the other hand, these studies use only the techniques which ignore structural breaks in the data generating process. As discussed in Gregory and Hansen (1996) the ignorance of structural breaks can cause non-rejection the null of no-cointegration while there is a long-run relationship between the variables. So there are two novelty elements in this study. First, to consider structural breaks in the cointegration relationship, we employ a recently introduced Fourier ADL cointegration test of Banerjee et al (2017). By using the Fourier ADL cointegration test, we do not need to determine the numbers or locations of the breaks. Second, contrary to other studies we focus on the effect of renewable energy consumption on unemployment rates.

The article is organized as follows. Section 2 presents the literature review on the relationship between renewable energy consumption and unemployment. Section 3 presents the econometric methodology and the data. Section 4 discusses the results of the study. In this section, the results obtained with the aforementioned methods are presented. This section also includes the economic policies, and the factors affecting the results for each country. Section 5 presents the conclusions of the study.

2. Literature review

The literature review on the relationship between renewable energy consumption and unemployment can be summarized as follows. Apergis and Salim (2015) investigated the dynamic relationship between renewable energy consumption and unemployment by employing nonlinear panel cointegration and causality tests. Their findings show that renewable energy consumption had a positive effect on unemployment rates from 1990–2013 in 80 countries. Payne (2009) studied the relationship between energy consumption and employment in the U.S. state of Illinois from 1976–2006 with the Toda-Yamamoto causality test and found a positive and statistically significant one-way causality between energy consumption and

employment. Hillebrand et al. (2006) conducted a study in Germany using the input-output model and focused on the economic effects, especially the effects on employment of the renewable energy support policy. In general, they found a wide effect arises from the additional investments and a restrictive effect related to the increase in the power generation costs. The first effect will lead to an increase in employment in the first years but, because of the second effect, it will stay at a negative level in the medium- to long-term. Lehr et al. (2008) used a similar model and however, a comprehensive survey has been conducted to produce input-output coefficients specific to the renewable electricity sector. Scenarios for future national and international energy development from the renewable sources are presented. Because of the study, it was found that the effect of renewable energy support policies in Germany is positive and that the policies reduced the ongoing long-term unemployment rate. Blazejczak et al. (2014) used the sectoral energy-econometric model to assess the employment effects of renewable energy support in Germany. The authors found that the net employment effects of renewable energy development are small but positive and that the size of the effects depends on the conditions and policies of the labor market. In his work in Denmark, Lund (2009) found that government subsidies in renewable energies had a net positive impact on employment. In this context, Lund (2009) focused on the importance of exports in the positive relationship between renewable energy support policies and employment by using the input-output method. The study also revealed that in countries where renewable energy investments increased employment, employment increased in the sectors in which the renewable energy technologies and their byproducts were produced for export rather than for the domestic market.

Rivers (2013) used a simple analytical general equilibrium model to study the relationship between renewable energy support policies and the unemployment rate. Rivers asserts that the subsidies encouraging the use of renewable energy and taxes paid by the traditional electricity producers to deter the consumption of fossil fuels will increase the unemployment rate. In particular, it is possible that renewable energy support policies may reduce the unemployment rate when the replacement possibilities between capital and labor are limited, the international mobility of the capital is limited, and the cost of the renewable electricity production technique is high in relation to the cost of labor. Ragwitz et al. (2009) estimated a net positive effect of renewable energy support policies on employment across the EU. They employed an input-output model and combined it with a macro-economic model. Kuster et al. (2007) examined the effects of renewable energy investment incentives in EU countries on various economic variables, including the level of employment, by employing a multi-sectoral, multi-regional general equilibrium model. The authors revealed that renewable energy subsidies increased the unemployment rate in the countries examined. Gonzalez et al. (2005) found that renewable energy consumption positively affects unemployment in the EU and Africa. Upandhyay and Pahuja (2010) assessed the potential employment created by the renewable energy technologies in India, especially in wind and solar energies. The two most developed countries in the wind power sector are Germany and China. Zhao and Luo (2017) revealed that renewable energy consumption has increased the employment rate in China. GWEC (2015) focused on the increase in employment in Germany created by renewable energy consumption and investments. Renewable energy, an open sector for

innovation, supports sustainable economic development with its contribution to employment in Europe (EREC, 2004).

Many studies have focused on predicting future gross employment effects and have ignored the effects among different sectors and countries. Markandya et al. (2016) first applied multiple regional input-output models in the field and this study analyzes not only the effects created directly and indirectly for each country, but also the employment effects created abroad as a result of international trade. The study focused on the period from 1995–2009, when the energy structure moved away from its carbon-intensive sources and toward more gas and renewable energies. The analysis shows that the shift in Europe, largely motivated by a transition to green economy, had a net positive effect on employment across the EU, especially in 21 of the 27 member-countries, and a third of the generated employment was created by the spill-over effects.

In this study, we employ a newly introduced cointegration test that allows structural breaks whose numbers, locations, or forms do not need to be known a priori. This methodology differentiates our study from the others in the literature.

3. Econometric methodology

A pioneering study by Perron (1989) shows the results of ignoring structural breaks when testing the stationarity of the series. In the case of disallowing structural breaks, the unit root tests will give misleading results when the data generating mechanism has structural breaks. On the other hand, structural breaks not only affect the results of unit root tests but also have effect on the results of cointegration tests. Cointegration tests by Gregory and Hansen (1996) and Hatemi-J (2011) allow structural breaks when analyzing long-term relationships. However, a significant shortcoming of these studies is that prior determination of the number of structural breaks, allowing more or fewer structural breaks in the data-creation process, will have misleading effects on the results. Although these tests model structural changes with the help of dummy variables, these variables only allow sudden changes and fail to model slower changes. In this study, we will avoid these deficiencies by using the cointegration test introduced by Banerjee et al. (2017).

Gallant (1981) and Gallant and Souza (1991) have shown that the Fourier approach can capture multiple breaks. After Becker et al. (2006), who use Fourier functions while testing the stationarity of the series, it has become popular to use Fourier functions in unit root analysis. Enders and Lee (2012) and Rodrigues and Taylor (2012) are, among others, also allow structural breaks by using Fourier functions.

Banerjee et al. (2017) developed a new cointegration test that includes Fourier functions to the Banerjee et al. (1998) cointegration test to allow the structural breaks. Banerjee et al. (2017) consider the following regression equation:

$$\Delta y_{1t} = d(t) + \delta_1 y_{1,t-1} + \gamma' y_{2,t-1} + \alpha \Delta y_{2t} + e_t \quad (1)$$

Where d (t) shows the deterministic term that can be defined as follows:

$$d(t) = \beta_0 + \phi_1 \sin\left(\frac{2\pi kt}{T}\right) + \phi_1 \cos\left(\frac{2\pi kt}{T}\right) \quad (2)$$

where t is the trend and T shows the number of observations; k represents a particular number of frequencies whose values can be determined by choosing the value that produces the minimum sum of squares. By implementing (2) into the equation (1) we obtain the following model:

$$\Delta y_{1t} = \beta_0 + \phi_1 \sin\left(\frac{2\pi kt}{T}\right) + \phi_1 \cos\left(\frac{2\pi kt}{T}\right) + \delta_1 y_{1,t-1} + \gamma' y_{2,t-1} + \alpha \Delta y_{2t} + e_t \quad (3)$$

We test the null of no cointegration ($\delta_1 = 0$) against the alternative of cointegration ($\delta_1 < 0$) using the following test statistic:

$$t_{ADL} = \frac{\hat{\delta}_1}{se\left(\hat{\delta}_1\right)} \delta_1 \quad (4)$$

where $\hat{\delta}_1$ and $se\left(\hat{\delta}_1\right)$ are the OLS estimator δ_1 and standard error of $\hat{\delta}_1$, respectively. Since this test is introduced to the literature recently, there is only one study in the literature employ this test. Lee et al. (2018) use Fourier ADL cointegration test to examine the long-run relationship between healthcare expenditure and GDP. Our study is the first that employ this cointegration test in the energy literature. In this study, we will estimate Equation 3, to test the existence of cointegration between renewable energy consumption and unemployment rates.

4. Data and Empirical results

This study examines the effect of renewable energy consumption on unemployment rates for the 12 countries from 1995–2016. The dataset was obtained annually and gathered from the OECD Data Service. Prior to the cointegration test, we needed to determine the integration levels of the variables. So, we employed the unit root test that introduced to the literature by Zivot and Andrews (1992) and present the results in Table 1.

	Level		First Differences	
Series	Test Statistics	Break Dates	Test Statistics	Break Dates
Reng_Australia	-1.9616 (3)	2010	-5.8629 (2)*	2007
Reng_Austria	-3.3103 (1)	2001	-5.7087 (3)*	2007
Reng_Chile	-2.3614 (1)	2010	-8.4870 (0)*	2009
Reng_Denmark	-4.7035 (3)	2007	-5.3708 (5)*	2004
Reng_France	-3.6927 (3)	2003	-4.9359 (0)*	2006
Reng_Germany	-1.9394 (2)	2010	-4.8921 (4)*	2009
Reng_Japan	-1.3088 (0)	2011	-5.7755 (7)*	2010
Reng_Mexico	-4.3592 (0)	2010	-6.7398 (0)*	2008
Reng_Portugal	-3.8755 (3)	2011	-5.4624 (1)*	2008
Reng_Spain	-2.1269 (1)	2011	-5.9181 (0)*	2013
Reng_United Kingdom	-4.2392 (0)	2009	-6.9582 (4)*	2007
Reng_USA	-4.2190 (3)	2006	-6.1462 (0)	2007
Unemp_Australia	-4.3416 (0)	2008	-5.0783 (0)*	2008
Unemp_Austria	-2.8204 (0)	2001	-5.3568 (0)*	2005
Unemp_Chile	-4.5196 (0)	2008	-5.1795 (3)*	2008
Unemp_Denmark	-4.0855 (0)	1999	-10.2040 (0)*	2008
Unemp_France	-3.7318 (3)	2007	-4.8782 (3)*	2012
Unemp_Germany	-3.9324 (0)	2002	-8.7124 (1)*	2005
Unemp_Japan	-3.2810 (1)	2000	-6.0598 (1)*	2007
Unemp_Mexico	-3.7702 (0)	2008	-4.8570 (0)*	2002
Unemp_Portugal	-3.4741 (1)	2011	-5.1196 (1)*	2013
Unemp_Spain	-3.0347 (1)	2003	-5.0462 (1)*	2008
Unemp_United Kingdom	-4.1910 (1)	2008	-7.8204 (1)*	2008
Unemp_USA	-4.5767 (3)	2008	-5.1820 (3)*	2008

Notes: Unemp, and Reng stand for unemployment rates and renewable energy consumption series respectively. Number in parantheses show the optimal lag length. * shows the significance. The critical value at the 10% level is 4.82.

Table 1. Zivot- Andrews Unit Root Test Results

As seen in Table 1, all the variables are stationary at the first differences, so we can pass to the second step where we test the long-run relationship between the variables. The FADL cointegration test results are reported in Table 2.

				LAGS	
	Frequency	t-stat	AIC	DY	DX
Australia	1	-3.82806***	0.824518	3	2
Austria	2	-3.60478***	0.814583	1	2
Chile	4	-5.76715*	2.273211	3	2
Denmark	1	-3.63308	2.170136	2	2
France	1	-3.814162*	1.440474	3	3
Germany	3	-4.90837**	0.985369	3	3
Japan	3	-5.80147*	-0.82036	3	3
Mexico	1	-4.07978***	0.587545	3	3
Portugal	1	-3.9105***	1.82616	3	2
Spain	2	-4.2372**	3.679461	3	1
United Kingdom	1	-3.06594	0.270152	3	3
US	1	-4.04405***	2.229562	3	3

Notes. *, ** and *** shows the significance at the 1%, 5% and 10% levels. For frequency 1, 2, 3 and 4, critical values at the 1%, 5% and %10 levels are -4.73, -4.09, -3.76; -4.44, -3.75, -3.37; -4.21, -3.51, -3.14; -4.07, -3.38, -3.03 respectively.

Table 2. Results of FADL Cointegration Test

The results show that most of the cointegration relationships can be modeled via one or two Fourier functions. We conclude that there is a cointegration relationship among the variables, except in the cases of Denmark and the United Kingdom. To measure the effect of renewable energy consumption on the unemployment rates in

the long-term, we estimated FMOLS (Fully Modified OLS) and tabulated the results in Table 3.

Countries	Constant	Renewable	Sin	Cos
Australia	6.786644 (0.00)	-0.434909 (0.0002)	0.136732 (0.4745)	1.497535 (0.00)
Austria	4.424085 (0.00)	0.434093 (0.0015)	-0.275194 (0.0203)	0.352493 (0.0051)
Chile	9.295243 (0.00)	-1.873925 (0.0122)	-0.783001 (0.1615)	-0.253566 (0.6565)
France	10.79437 (0.00)	-0.360424 (0.0019)	-0.633185 (0.0596)	2.15587 (0.00)
Germany	9.799654 (0.00)	-0.141262 (0.0004)	0.453802 (0.4104)	-0.445743 (0.4261)
Japan	5.015976 (0.00)	-0.112202 (0.0282)	-0.145735 (0.571)	0.231617 (0.3645)
Mexico	4.984657 (0.00)	-0.455131 (0.1046)	-1.372805 (0.0001)	0.425475 (0.092)
Portugal	7.346448 (0.00)	1.309233 (0.059)	-2.162398 (0.0772)	0.080796 (0.8922)
Spain	11.74073 (0).000	0.705596 (0.0099)	1.143503 (0.5625)	0.186549 (0.9235)
US	6.965126 (0.00)	-0.032166 (0.2893)	-2.336508 (0.0078)	-0.105818 (0.8661)

Note: Numbers in parantheses show the p-values.

Table 3. Results of Long-Run Estimates

We concluded that renewable energy consumption positively affects the unemployment rates in Austria, Portugal, and Spain, while it negatively affects the unemployment rates in Australia, Chile, France, Germany, and Japan. Meanwhile, there has been no effect in Mexico or the US.

Germany, France, and Japan are among the countries that make the biggest investments in renewable energy sources, R&D, and production areas and create the most employment in the renewable energy sector (UNEP, 2011). Renewable energy support policies (e.g., financial incentives, tax exemptions, production incentives) clearly have a positive effect on unemployment in these countries (Bacak et al., 2009; Lehtovaara et al., 2013; Strunz et al., 2016). In addition, the increase in employment in the countries' energy sector depends on the development of exports (Lund, 2009: 53; IRENA, 2015; GWEC, 2015: 44). Australia, where a positive relationship is seen again between renewable energy consumption and employment rates, encourages the use of wind energy, the largest employment area in the renewable energy sector, through direct and indirect support mechanisms (Altuntaşoğlu, 2009; EWEA, 2009; Nigel and Rice, 2012). Like Germany and France, Australia has also legislated for official national policies in the renewable energy sector (IEA; 2009; Tepp, 2012; Nigel and Rice, 2012). Chile, which also shows a positive relationship between renewable energy consumption and employment, is among the most advantageous countries in terms of geothermal energy, one of the most important renewable energy sources (Ilgar, 2005). Chile is actively supported and financed in the employment field within the scope of the "Green-Collar Jobs Program" of the International Labour Organization.

The expansion of renewable energy consumption can lead to an increase in unemployment during periods of economic crisis (Apergis and Salim, 2015). Spain, Portugal, and Austria, where a negative relationship is seen between renewable energy consumption and employment, are among the countries most affected by the global economic crisis. Serious decreases in growth rates and important increases in unemployment rates were seen in these countries after the global economic crisis (EurObserv'ER, 2016). Moreover, in the renewable energy sector of Austria, the

number of people dismissed due to general and local policies is increasing rapidly. In Austria, where the labor costs are high, unemployment in the wind energy sector is related to the completion of installations rather than operations (Lambert and Silva, 2012; Abdmouleh et al., 2015). However, in Portugal, which largely depends on foreign oil, natural gas, and coal resources and has a high current account deficit, the fluctuations in oil prices have had a negative effect on inflation and unemployment (Robalo and Salvado, 2008).

5. Conclusion

In this study, we tested the effect of the consumption of renewable energy on the unemployment rates for 12 OECD countries by implementing a new cointegration test developed by Banarjee et al. (2017). The biggest advantage of this test is that the number, form, and location of structural breaks do not need to be determined a priori. Among the countries examined, in the long run, the consumption of renewable energy is found to have no significant effect on the employment rates in Mexico and the United States. In Australia, Chile, France, Germany, and Japan, renewable energy consumption was found to have a negative effect on unemployment. In Austria, Portugal, and Spain, it was found to be effective in the positive direction. The results generally show that renewable energy consumption has the effect of creating jobs. Renewable energy and its technologies are seen as sources of employment. This effect varies depending on factors such as the size of the investment, supporting policy, national energy systems, and general progress in economic development, market size, quality, and cost (UNEP, 2011).

When we focus on countries where renewable energy consumption has a positive effect on unemployment rates, it can be said that this is mainly due to the serious decline in growth rates as a result of the global economic crisis. In Australia, Chile, France, Germany, and Japan, countries where we examine the negative relationship between renewable energy consumption and unemployment rates, it can be seen that this is due to the size of the investment and supporting policies for renewable energy. We observe that countries with a positive relationship between renewable energy consumption and unemployment rates have adopted three main policies in the field of renewable energy: fiscal incentives, tax exemptions, and production incentives. They do this to accelerate their investments and formulate official national policies through law enforcement. Meanwhile, in countries where renewable energy investments have increased employment, the sectors in which renewable energy technologies and their by-products are produced for export rather than for the domestic market have increased employment rates.

In this context, it is clear that government-supported loans for renewable energy, legislation on renewable energy, and incentives provided to investors are important methods to increase the employment rate. In addition, policies to reduce foreign-sourced energy dependency will positively affect the employment rates in the renewable energy sector.

References

Abdmouleh, Z., Alammari, R. A., & Gastli, A. (2015). Review of policies encouraging renewable energy integration & best practices. Renewable and Sustainable Energy Reviews, 45, 249-262.

Altuntaşoğlu, Z. (2009). Yerli rüzgâr enerji teknoloji üretimi destek politikaları ve Türk mevzuatı. TMMOB Türkiye VI. Enerji Sempozyumu-Küresel Enerji Politikaları ve Türkiye Gerçeği 377-389.

Apergis, N., & Salim, R. (2015). Renewable energy consumption and unemployment: evidence from a sample of 80 countries and nonlinear estimates. Applied economics, 47(52), 5614-5633.

Apergis, N., & Payne, J. E. (2011). The renewable energy consumption–growth nexus in Central America. Applied Energy, 88(1), 343-347.

Apergis, N., & Payne, J. E. (2010). Renewable energy consumption and economic growth: evidence from a panel of OECD countries. Energy policy, 38(1), 656-660.

Apergis, N., & Payne, J. E. (2010). Renewable energy consumption and growth in Eurasia. Energy Economics, 32(6), 1392-1397.

Apergis, N., Payne, J. E., Menyah, K., & Wolde-Rufael, Y. (2010). On the causal dynamics between emissions, nuclear energy, renewable energy, and economic growth. Ecological Economics, 69(11), 2255-2260.

BACAK, S., KÜLCÜ, R., & EKİNCİ, K. (2009). Türkiye ve AB Ülkelerinde Yenilenebilir Enerji Kaynakları Politikaları ve Hedefler. Tarım Makinaları Bilimi Dergisi, 5(1), 9-14.

Bakırtaş, İ., Çetin, M.A. (2016). Yenilenebilir enerji tüketimi ile ekonomik büyüme arasındaki ilişki: G-20 ülkeleri. Sosyoekonomi, 24(28),131-145.

Banerjee, A., Dolado, J., & Mestre, R. (1998). Error-correction mechanism tests for cointegration in a single-equation framework. Journal of time series analysis, 19(3), 267-283.

Banerjee, P., Arčabić, V., & Lee, H. (2017). Fourier ADL cointegration test to approximate smooth breaks with new evidence from crude oil market. Economic Modelling, 67, 114-124.

Bayraktar, Y., Kaya, H.İ., 2016. Yenilenebilir enerji politikaları ve rüzgar enerjisi açısından bir karşılaştırma: Çin, Almanya ve Türkiye. Uluslararası Ekonomik Araştırmalar Dergisi, 2(4), 1-18.

Becker, R., Enders, W. and Lee, J. (2006). A stationarity test in the presence of an unknown number of smooth breaks. Journal of Time Series Analysis, 3(5): 381-409.

Bilgili, F., Ozturk, I., Kocak, E., & Bulut, U. (2017). Energy consumption-youth unemployment nexus in Europe: Evidence from panel cointegration and panel causality analyses. International Journal of Energy Economics and Policy, 7(2), 193-201.

Blazejczak, J., Braun, F. G., Edler, D., & Schill, W. P. (2014). Economic effects of renewable energy expansion: A model-based analysis for Germany. Renewable and sustainable energy reviews, 40, 1070-1080.

Enders, W., & Lee, J. (2012). A unit root test using a Fourier series to approximate smooth breaks. Oxford bulletin of Economics and Statistics, 74(4), 574-599.

EREC. (2004). Renewable energy target for Europe, Brussels, 2-3.

EurObserv, E. R. (2011). The state of renewable energies in Europe. EurObserv'ER Report, 11, 1-248.

European Wind Energy Association (EWEA), 2009. Wind Energy The Facts: Executive Summary, http://www.ewea.org/fileadmin/files/library/publications/reports/Wind_at_work.pdf (accessed 31 March 2018).

Fang, Y. (2011). Economic welfare impacts from renewable energy consumption: the China experience. Renewable and Sustainable Energy Reviews, 15(9), 5120-5128.

Gallant, A. R. (1981). On the bias in flexible functional forms and an essentially unbiased form: the Fourier flexible form. Journal of Econometrics, 15(2), 211-245.

Gallant, A. R., & Souza, G. (1991). On the asymptotic normality of Fourier flexible form estimates. Journal of Econometrics, 50(3), 329-353.

George, E. O., & Oseni, J. E. (2012). The relationship between electricity power and unemployment rates in Nigeria. Australian Journal of Business and Management Research, 2(2), 10.

Gonzalez, A., Terasvirta, T., Dijk, D. (2005). Panel smooth transition regression models. Working Paper Series in Economics and Finance, 604, Stockholm School of Economics, Stockholm.

Global Wind Energy Council (GWEC), 2015. Global Wınd Report. http://gwec.net/publications/global-wind-report-2/global-wind-report-2015-annual-market-update/ (accessed 31 March 2018).

Gregory, A. W., & Hansen, B. E. (1996). Residual-based tests for cointegration in models with regime shifts. Journal of econometrics, 70(1), 99-126.

Hatemi-j, A. (2008). Tests for cointegration with two unknown regime shifts with an application to financial market integration. Empirical Economics, 35(3), 497-505.

Hillebrand, B., Buttermann, H. G., Behringer, J. M., & Bleuel, M. (2006). The expansion of renewable energies and employment effects in Germany. Energy Policy, 34(18), 3484-3494.

Ilgar, R. (2005). Ekolojik bakışla jeotermal kaynaklara dualist yaklaşım. Elektronik Sosyal Bilimler Dergisi, 4(13), 88-98.

The International Energy Agency (IEA), (2009). Global Renewable Energy Policies and Measures 2009. https://www.iea.org/policiesandmeasures/ (accessed 31 March 2018).

International Renewable Energy Agency (IRENA), (2015). International Renewable Energy Agency Annual Review. Renewable Energy and Jobs. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2015.pdf, (accessed 10 February 2018).

Karaca, C., Ulutaş, A., & Eşgünoğlu, M. (2017). Türkiye'de optimal yenilenebilir enerji kaynağının COPRAS yöntemiyle tespiti ve yenilenebilir enerji yatırımlarının istihdam artırıcı etkisi. Maliye Dergisi, 172, 111-132.

Kammen, D.M., Kapadia, K. Fripp, M., 2004. Putting renewables to work: how many jobs can the clean energy industry generate? University of California Berkeley, Report of the Renewable and Appropriate Energy Laboratory. http://rael.berkeley.edu/sites/default/files/very-old-site/renewables.jobs.2006.pdf (accessed 10 February 2018).

Lambert, R. J., & Silva, P. P. (2012). The challenges of determining the employment effects of renewable energy. Renewable and Sustainable Energy Reviews, 16(7), 4667-4674.

Lehr, U., Nitsch, J., Kratzat, M., Lutz, C., & Edler, D. (2008). Renewable energy and employment in Germany. Energy policy, 36(1), 108-117.

Lee, H., Oh, D. Y., & Meng, M. (2019). Stationarity and cointegration of health care expenditure and GDP: evidence from tests with smooth structural shifts. Empirical Economics, 57(2), 631-652.

Lehtovaara, M., Karvonen, M. and Kassi, T. (2013). The role of energy support schemes in renewable energy market penetration. International Journal of Renewable and Sustainable Energy, 2(2), 30-40.

Lund, P. D. (2009). Effects of energy policies on industry expansion in renewable energy. Renewable energy, 34(1), 53-64.

Makower, J., Pernick, R., Wilder, C. (2009). Clean Energy Trends 2009, Clean Edge Inc. http://www.cleanedge.com/ reports/pdf/Trends2009.pdf, (accessed 10 February 2018).

Markandya, A., Arto, I., González-Eguino, M., & Román, M. V. (2016). Towards a green energy economy? Tracking the employment effects of low-carbon technologies in the European Union. Applied energy, 179, 1342-1350.

Menyah, K., & Wolde-Rufael, Y. (2010). CO2 emissions, nuclear energy, renewable energy and economic growth in the US. Energy Policy, 38(6), 2911-2915.

Moreno, B., & Lopez, A. J. (2008). The effect of renewable energy on employment. The case of Asturias (Spain). Renewable and Sustainable Energy Reviews, 12(3), 732-751.

Moreno, B., & Lopez, A. J. (2008). The effect of renewable energy on employment. The case of Asturias (Spain). Renewable and Sustainable Energy Reviews, 12(3), 732-751.

NREL (1997). Dollars from sense the economic benefits of renewable energy, national renewable energy labaratory, U.S. department of energy, Washington.

OECD (2004). Environment and Employment: An Assessment", Working Party on National Environmental Policy, Environment Policy Committee. http://www.oecd.org/dataoecd/13/44/31951962.pdf (accessed 31 March 2018).

Orucu, A.Y. Alp, K. (2007). İklim değişikliği sürecinde yenilenebilir enerji kaynakları. Uluslararası Küresel İklim Değişikliği ve Çevresel Etkileri Konferansı, Konya, Türkiye.

Özsoy, E.C. (2016). Yeşil İşler ve İstihdam Olanakları Üzerine Bir Tartışma. Aksaray Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 8(1) , 51-59.

Öztürk, I. (2010). A literature survey on energy–growth nexus. Energy policy, 38(1), 340-349.

Payne, J. E. (2009). On the dynamics of energy consumption and employment in Illinois. Journal of Regional Analysis and Policy, 39(1100-2016-89639).

Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. Econometrica: Journal of the Econometric Society, 1361-1401.

Ragwitz, M., Schade, W., Breitschopf, B., Walz, R., Helfrich, N., Rathmann, M., Resch, G., Panzer, C., Faber, T., Haas, R. (2009). The impact of renewable energy policy on economic growth and employment in the European Union. European Commission, DG Energy and Transport, Brussels, Belgium.

Robalo, P.B. and Salvado, J.C. (2008). Oil Price Shocks and the Portuguese Economy since the 1970s. FEUNL Working Paper Series 529. http://ideas.repec.org/p/unl/unlfep/wp529.html (accessed 31 March 2018).

Rodrigues, P. M., & Robert Taylor, A. M. (2012). The Flexible Fourier Form and Local Generalised Least Squares De-trended Unit Root Tests. Oxford Bulletin of Economics and Statistics, 74(5), 736-759.

Rivers, N. (2013). Renewable energy and unemployment: A general equilibrium analysis. Resource and Energy Economics Journal, 35, 467-485.

Sadorsky, P. (2009). Renewable energy consumption and income in emerging economies. Energy Policy, 37, 4021–4028.

Strunz, S., Gawel, E., Lehmann, P. (2016). The political economy of renewable energy policies in Germany and the EU. Utilities Policy, 42, 33-41.

Tepp, M., Schachtschneider, R., & Brückmann, R. (2012). The promotion of wind power in Germany and Finland. A Comparative Overview on Legislation, Eclareon, Berlin.

UNEP, U. (2011). Towards a green economy: Pathways to sustainable development and poverty eradication. Nairobi, Kenya: UNEP.

Upadhyay, H., & Pahuja, N. (2010). Low-carbon employment potential in India: A climate of opportunities. Centre for Global Climate Research TERI and Global Climate Framework Discussion Paper TERI/GCN–2010, 1.

Zhao, X., & Luo, D. (2017). Driving force of rising renewable energy in China: Environment, regulation and employment. Renewable and Sustainable Energy Reviews, 68, 48-56.

Zivot, E., Andrews, D. (1992). Further evidence of great crash, the oil price shock and unit root hypothesis. Journal of Business and Economic Statistics, 10, 251-70.